UP TO THE HYPE: AN OVERVIEW OF "2ND GENERATION" ATAD PERFORMANCE

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WHAT IS AN ATAD?

- ATAD STANDS FOR
- **A**utothermal
- **T**hermophilic
- **A**erobic
- **D**igestion

WHAT DOES THAT MEAN?

- Autothermal – the sludge is self heating from the heat given off by digestion
- Thermophilic – The sludge temperature is above 110 degrees F (Actually it will be between 140 and 150 degrees F , or 60 – 65 degrees C)

WHAT DOES THAT MEAN?

- Aerobic – the sludge is in an oxidizing state. There may be dissolved oxygen at some times
- Digestion – the process destroys solids

ATAD EVOLUTION

- Began in 1970's as pure oxygen
- Aerobic thermophilic pretreatment for CBI and others

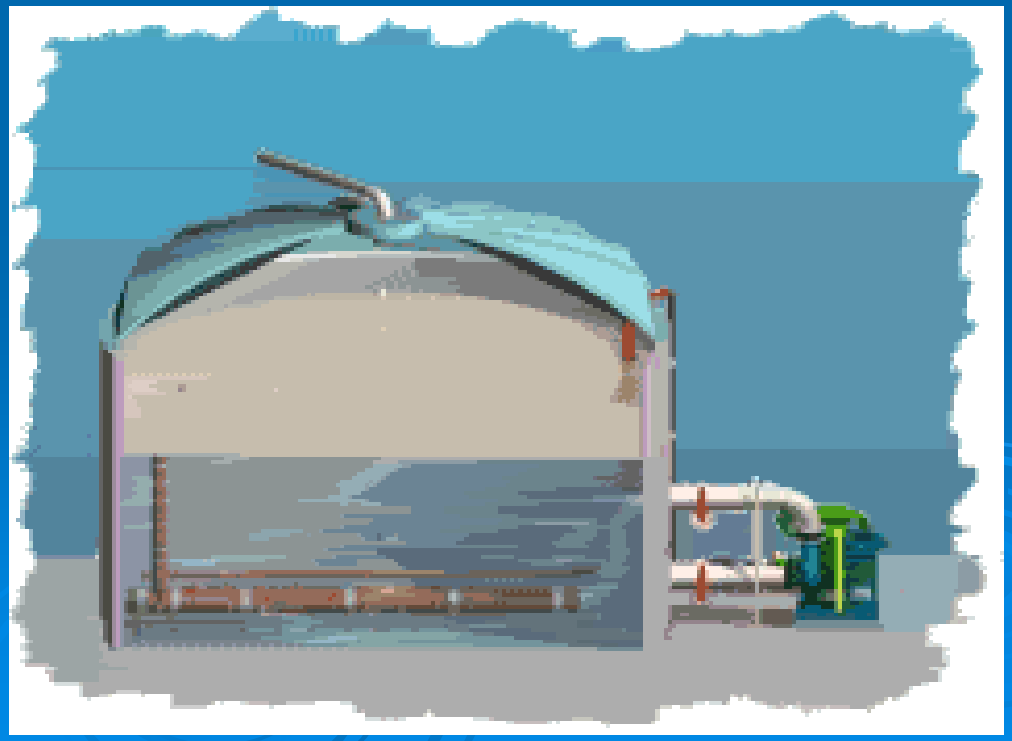
1980s-90s

- USEPA endorses ATAD concept for Class A biosolids. Economical means to meet EQB for average size plants
- Fuchs and Dayton-Knight begin installing units
- Problems with odors foaming and dewatering

Whistler BC ATAD (Dayton/Knight)

1990s

- "2nd Generation" ATAD from Thermal Process developed for Staley Starch in Lafayette IN



MAJOR DIFFERENCES BETWEEN TPS AND OTHER ATADS

	Thermal Process	Others
SRT	10-14 days 1 stage	6-8 days multi stage
Air Supply	Blower	Aspirated
ORP Control	Yes	Impossible
Foam Control	Hydraulic	Mechanical
Meso stage	Yes, controlled	No

THE BIG ADVANCE:

- THERMO-MESO STAGING WITH SNDR, OR:
  - **S**torage
  - **N**itrification and
  - **D**enitrification
  - **R**eactor

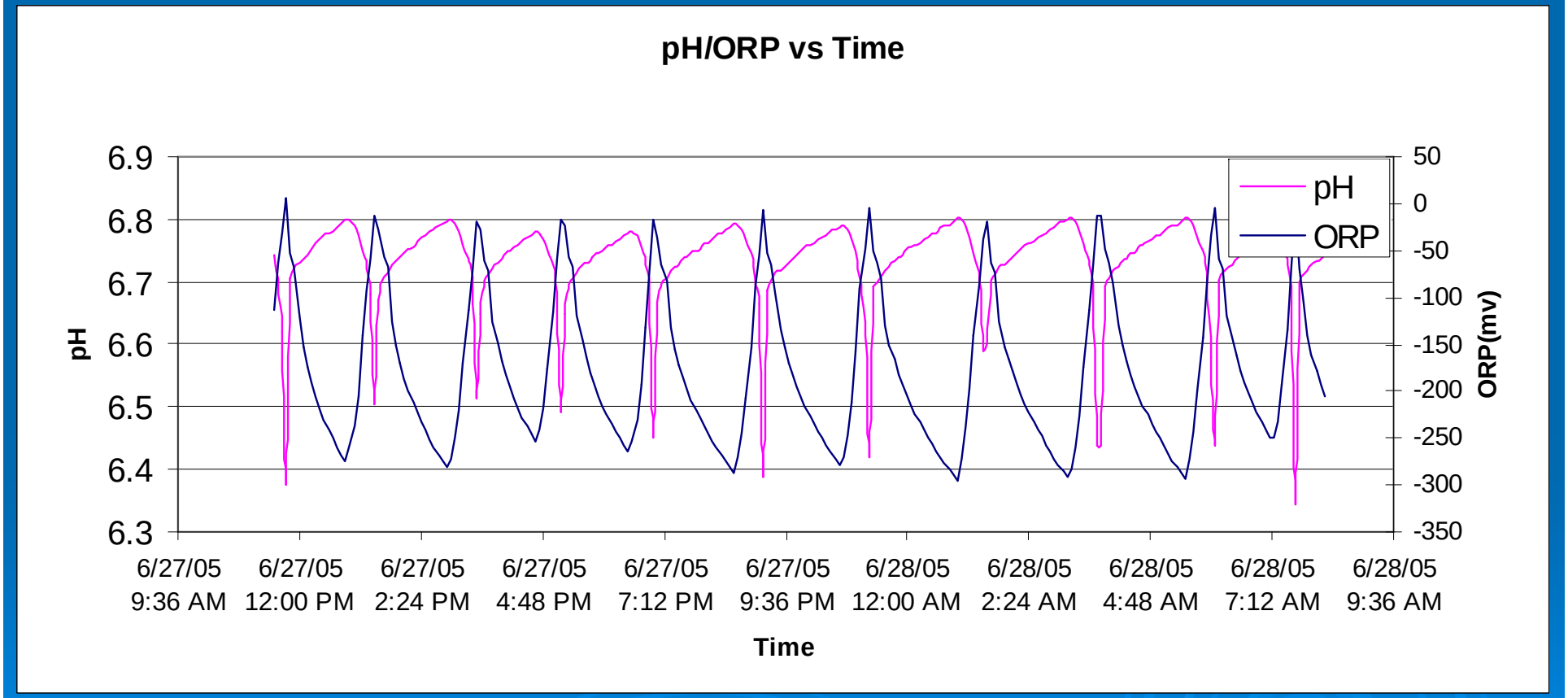
SNDR REACTOR

- Stands for “Storage Nitrification/Denitrification Reactor
- Removes 50% of ammonia from off gas
- Provides an additional 15% TS reduction
- Reduces ammonia and biopolymers by 65-80%.
- Reduces dewatering polymer and coagulant demand
- Heat loss by radiator and heat exchanger

WHAT IS SNDR?

- Mesophilic aeration
- Cooled by heat exchanger to <95F
- 6+days HRT
- Aeration based on pH
- Nitrification creates acid, lowers pH
  - Denitrification creates base, raises pH
  - ATAD pH typically >8
  - SNDR pH 6.5-7

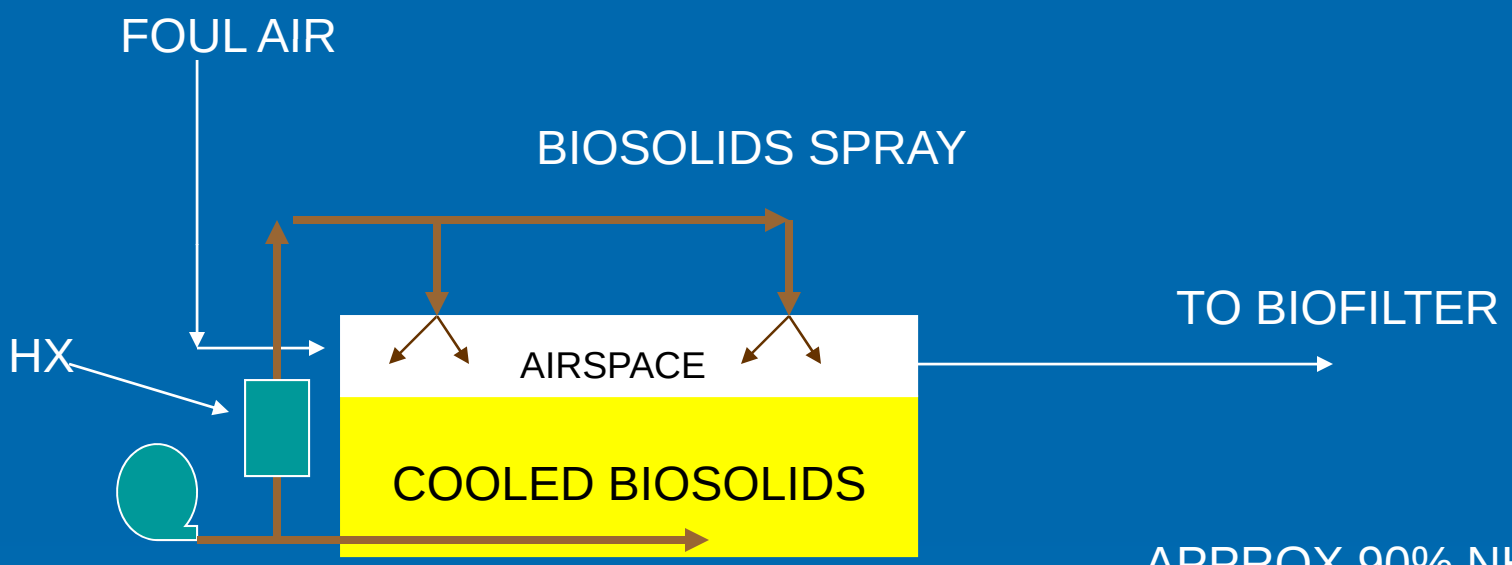
pH and ORP in SNDR



BENEFITS OF SNDR

- Increased TS reduction
- Biopolymer reduction
- Ammonia reduction
- pH control
- Temperature reduction
- Part of odor control too

SNDR AND ODOR CONTROL

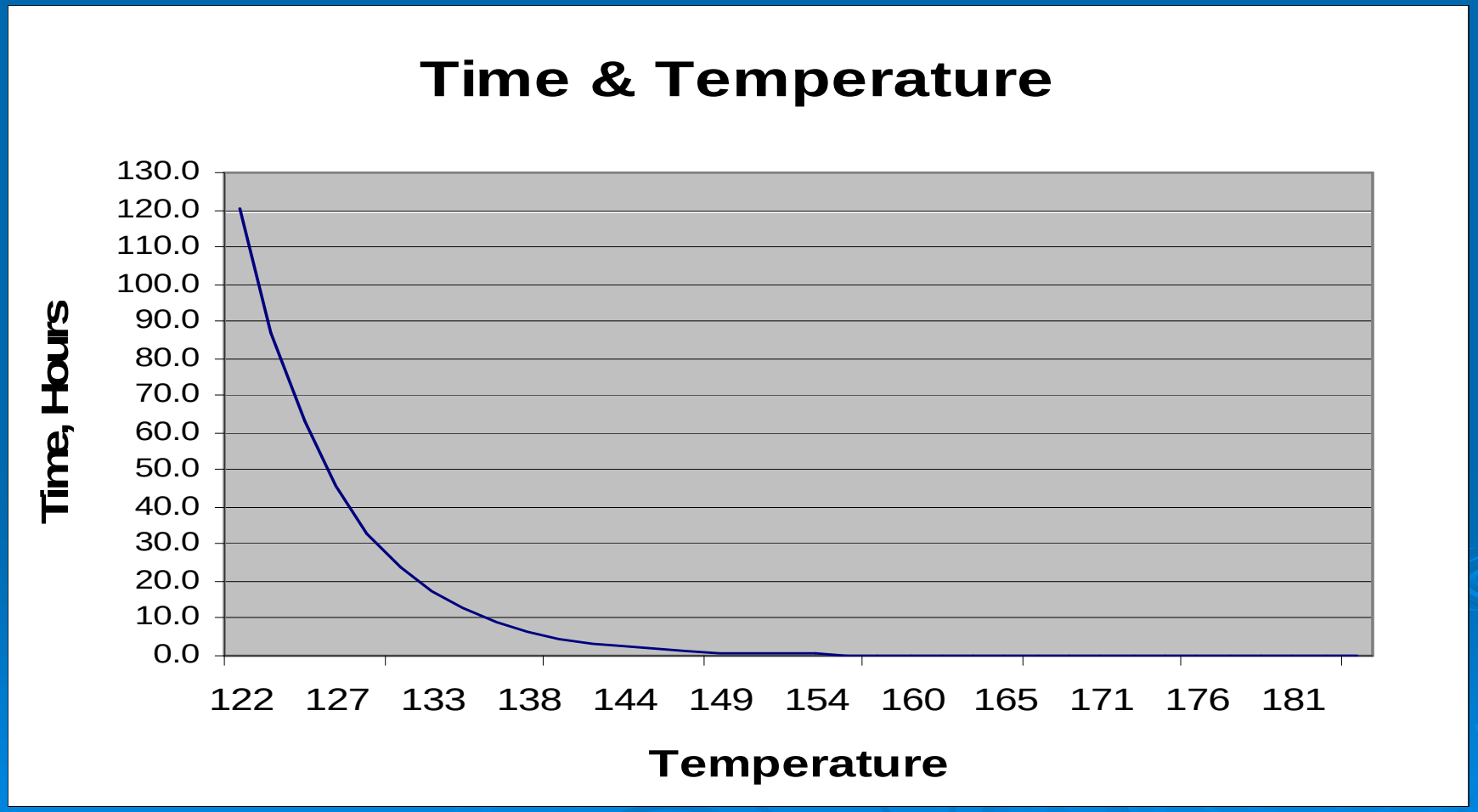


APPROX 90% NH3 REDUCTION IN AIR, HUMIDIFICATION OF AIR

ATAD INSTALLATIONS

SITE	CAPACITY, TPD	SOLIDS PROCESSED
STALEY	15	TWAS
3 RIVERS MI	4	PRIM+TWAS+SEPT
YORKVILLE IL	2	TWAS
BG OH	8	PRIM+WAS+SEPT
MOREHEAD KY	3	PRIM+WAS
DELPHOS OH	4.5	TWAS
KAUKAUNA WI	11	PRIM+WAS
MARSHALL MN	6	PRIM+WAS

TIME AND TEMPERATURE



STALEY STARCH, W.LAYFAYETTE IN

- First Plant
- 15 Dry Tons/day (TPD)
- Industrial
- Invented here because they were drowning in biosolids

BEFORE AND AFTER

- Dewatering 24 Hrs/day
- 12-14% solids
- Land applied after reliquefacation
- Odor Complaints
- Angry Neighbors
- Holding up plant production

- Dewater 3 days wk, 8 hrs day
- 18% cake solids
- Mixed with horse stall waste AND SOLD
- Everyone is happy

INNOVATIONS

- Everything
  - Sonic horns for foam control (abandoned)
  - Fiberglass covers (abandoned)

THREE RIVERS MICHIGAN

- 2.5 MGD Design
- Odor Complaints
- Failing Digesters
- Septage overloaded plant

INNOVATIONS

- First municipal plant
- Treats septage primary and TWAS

INNOVATIONS

- Foam control by “Foam Cones”
- Dedicated storage and cool-down tank
- First biofilter

THE RESULTS

- 45% TS Reduction
- 55% VS reduction
- Hydraulic loading rate more than design
- Accepts 25,000 gpd septage at 1.5 MGD flow
- Biosolids given away

PROBLEMS (NOTHING'S PERFECT…)

- Feed sludge thinner than design
- Feed volume higher than design
- The usual PLC bugs
- Storage tank intermittently thermophilic – higher polymer doses
- Hard water to biofilter caused stalactites to grow in humidification chamber

YORKVILLE ILLINOIS

- 2. MGD
- Plant expansion
- Tight Site
- Wanted to Reduce Biosolids Production

INNOVATIONS

- New foam control scheme
- Heat exchanger to cool down sludge
- First SNDR tank
- Cast in place concrete cover

SPRAYCONES FOR
FOAM CONTROL

THE RESULTS?

- 50% TS Reduction
- SNDR reduced polymer and chemical dose
- Cake solids 28% with 100% WAS feedstock
- Cake certified as compost

BOWLING GREEN OHIO

- 5 MGD Flow
- Plant expansion
- Stinky aerobic digesters
- High power cost
- Insufficient storage

WHY ATAD?

- Potential for cost savings
- Biggest reduction – aeration power reduced from 900 Hp to ~~450~~ 350 Hp

INNOVATIONS

- CONTINUOUS FEED – NO DRAW AND FILL
- Processes co-settled primary and secondary solids
- Open-topped liquid storage
- Shared aeration system with aeration tanks
- Removable aluminum covers

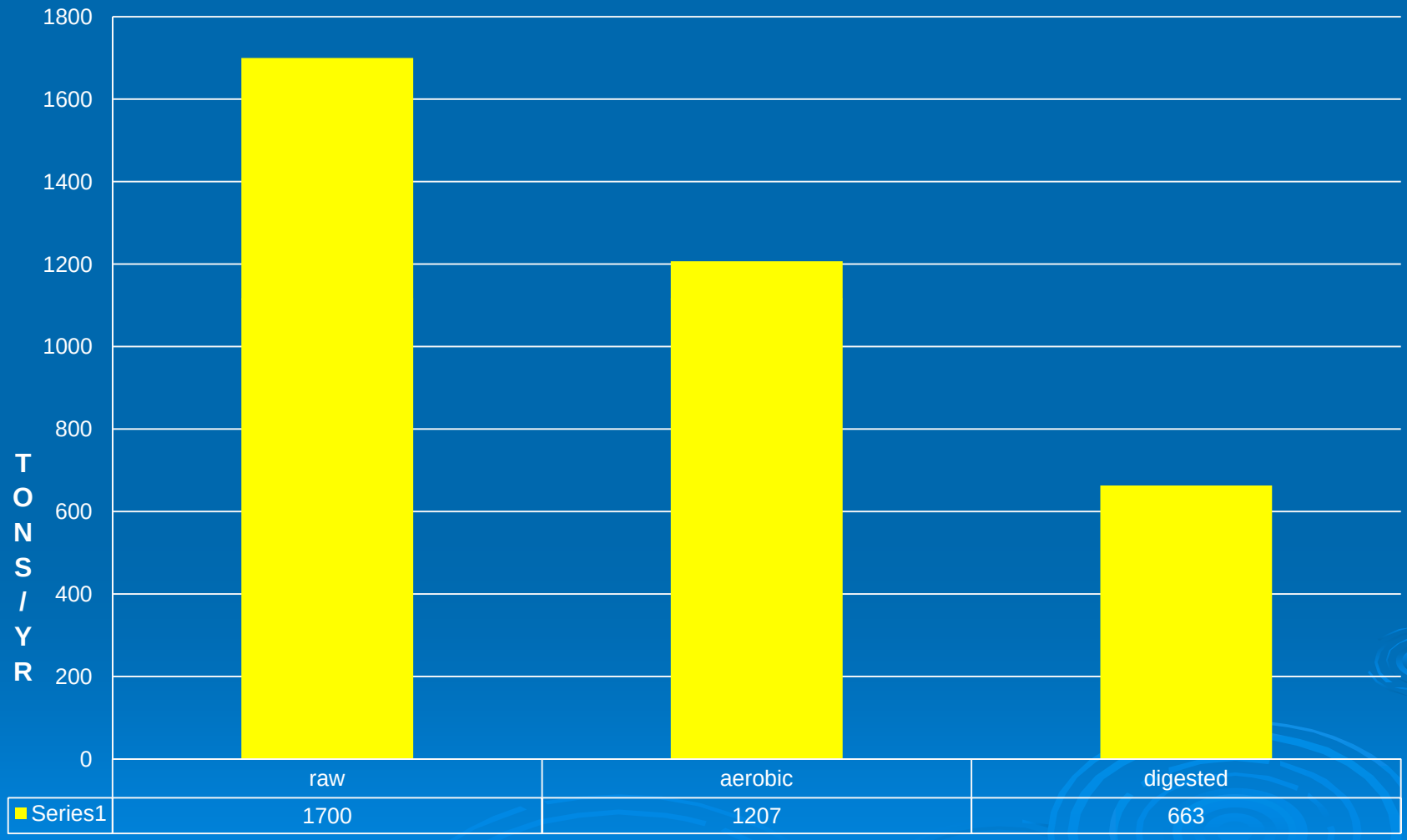
INNOVATIONS

- Passive radiator to cool SNDR
- Supernating
- Liquid land application

THE RESULTS

- Up to 65% TS reduction
- 75% VS reduction
- 40% cake solids
- Polymer dose of 9 Lbs active/dt with centrifuge
- Biosolids cake now sent to soil blender
- Costs reduced $390,000/yr compared to aerobic digestion

ATAD VS AEROBIC DIGESTION BOWLING GREEN



PROBLEMS

- Excessive heat loss from covers
- Heat exchanger fouling from non-chlorinated NPW caused nitrification failure at 109 F
- Passive heat exchanger not covered, acted as heater on sunny days
- Grit accumulation
- Getting sufficient air from common air supply

MOREHEAD, KY

- Retrofit of anaerobic digesters
- Capacity 6,600 Lbs day

MOREHEAD CONTROL PANEL AND BIOFILTER

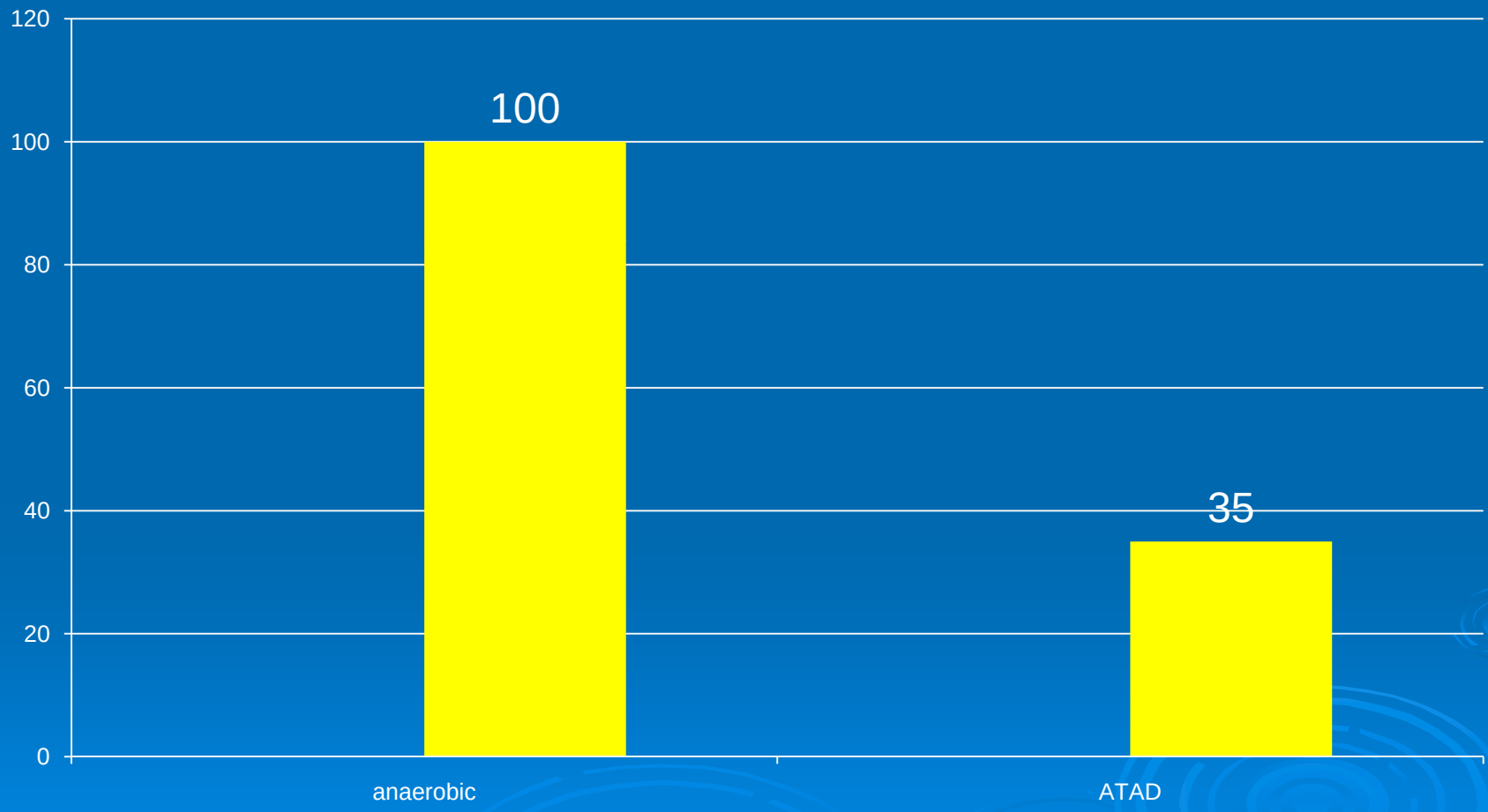
INNOVATIONS

- First poured in place cover on retrofit
- First cake storage in building – no odor no flies, no regrowth

THE RESULTS

- 65% reduction in sludge cake to fields
- Cake solids went from 15% to 21%
- Elimination of anaerobic digester recycle caused aeration tank blower to be oversized (OOPS!)
- Maintains temperature with only 2% feed solids

CHANGE IN LOADS TO FIELD, MOREHEAD KY



DELPHOS OH

- Part of new plant design
- Digests MBR sludge, which is well-oxidized
- Capacity is 8,800 Lbs/day

PD BLOWERS IN SOUND REDUCING ENCLOSURES – DELPHOS OH

INNOVATIONS

- Treats gravity belt thickened MBR WAS, a low volatile waste

INNOVATIONS

- Heat exchanger moved to ATAD transfer line instead of sidestream

THE RESULTS

- 63% VS Reduction
- 50% TS reduction
- 22% cake solids with belt press
- $170,000 savings/yr in dewatering/disposal costs (sludge is given away)

Heart of the Valley, Wisconsin

- Treats Actiflo primary sludge and Biostyr WAS
- Capacity 21,800 Lbs/day

INNOVATIONS

- Treats Actiflow primary waste and Biostyr secondary waste
- First unaerated liquid storage
- First use of existing anaerobic digester cover
- Passive radiator
- abandoned

THE RESULTS

- 63% VS reduction
- 56% TS reduction
- No odors
- Good supernating
- Liquid land application costs reduced $150,000/yr

MARSHALL MINNESOTA

- Anaerobic digester retrofit
- Capacity 12,000 Lbs/day
- Plant flow 2 MGD, heavy industrial waste from ADM
- Primary and TWAS

WHY AN ATAD?

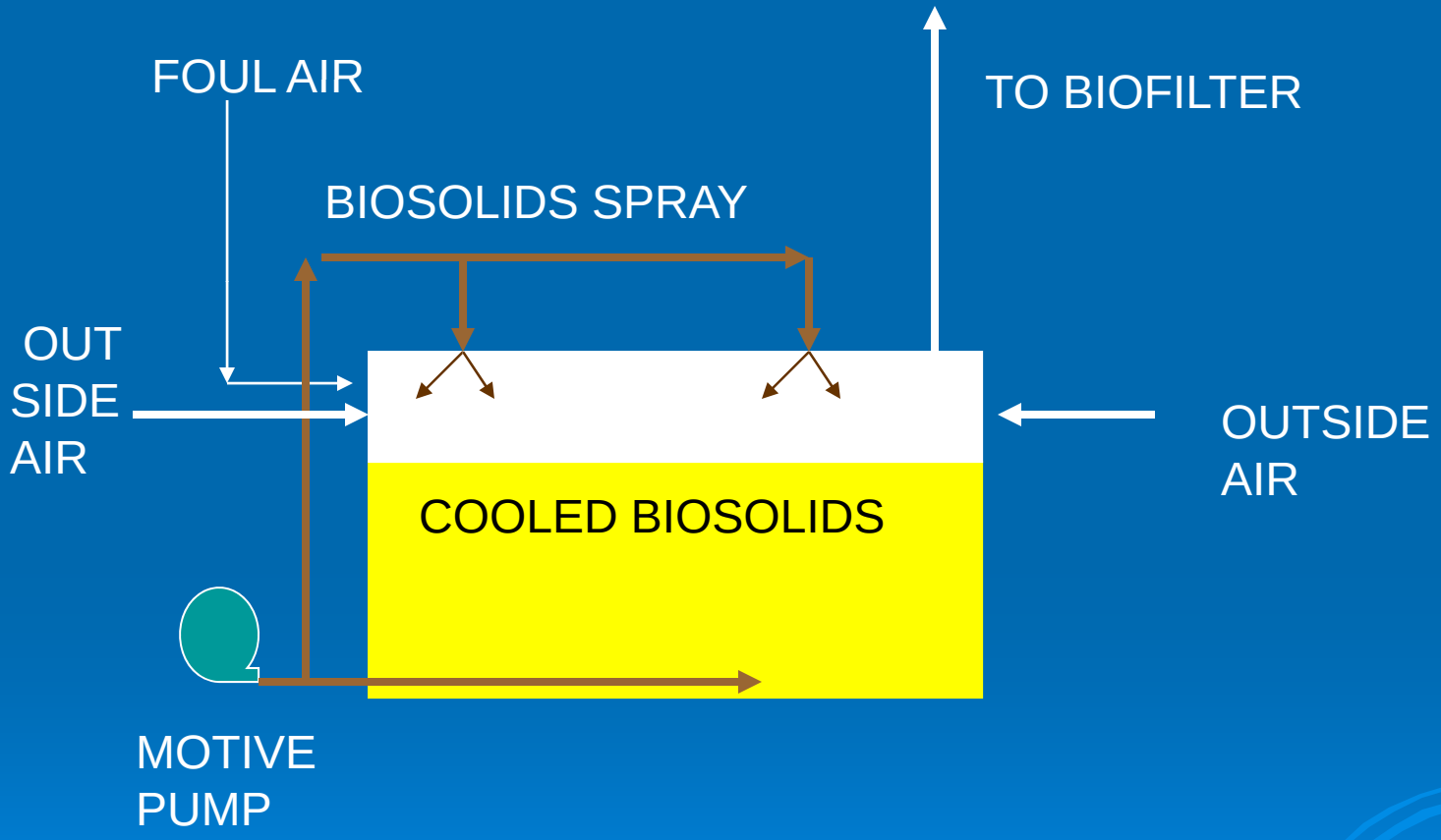
- Anaerobic digester covers failed after 11 years: $1 million to replace. Other equipment in need of replacement.
- ATAD produced fewer biosolids for equivalent costs

EQUIPMENT LAYOUT

INNOVATIONS

- Eliminated water/sludge HX
- Replaced it with “cooling tower” or “swamp cooler” HX

NEW AND IMPROVED SWAMP COOLER



THE RESULTS

- 60% TS reduction
- 65% VS reduction
- Digested biosolids decant to >5% TS
- Anaerobic sludge only decanted to 2.5%
- 67% reduction in land application cost
- Supernatant ammonia only 56 mg/L
- Reactor Temp: 155F 21 minutes pathogen kill time

SUMMARY OF RESULTS

PLANT	TS REDUCTION	VS REDUCTION
3 RIVERS MI	45	55
YORKVILLE IL	50	65
BG OH	61	72
MOREHEAD KY		
DELPHOS OH	50	65
KAUKAUNA WI	56	63
MARSHALL MI	60	65

THE IMPORTANCE OF THE SNDR IN ATAD OPERATION

- Thermo-Meso operation improves:
  - TS reduction
  - Biopolymer reduction
  - Ammonia reduction

WHAT ARE BIOPOLYMERS, ANYWAY?

- Biopolymers are very small thin strands of organic polymer
- They result from cell lysis
- Much more common in thermophilic systems than mesophilic systems
- Think of them as angel hair pasta with the solids being the occasional meatball

WHAT DO THEY DO?

- They are negatively charged and suck up all the charges in your cationic dewatering polymer
- They greatly increase the polymer required for dewatering
- Some first generation ATADs (Grand Chute WI for one) had dewatering doses of 100 Lbs polymer /dry ton (YES!)

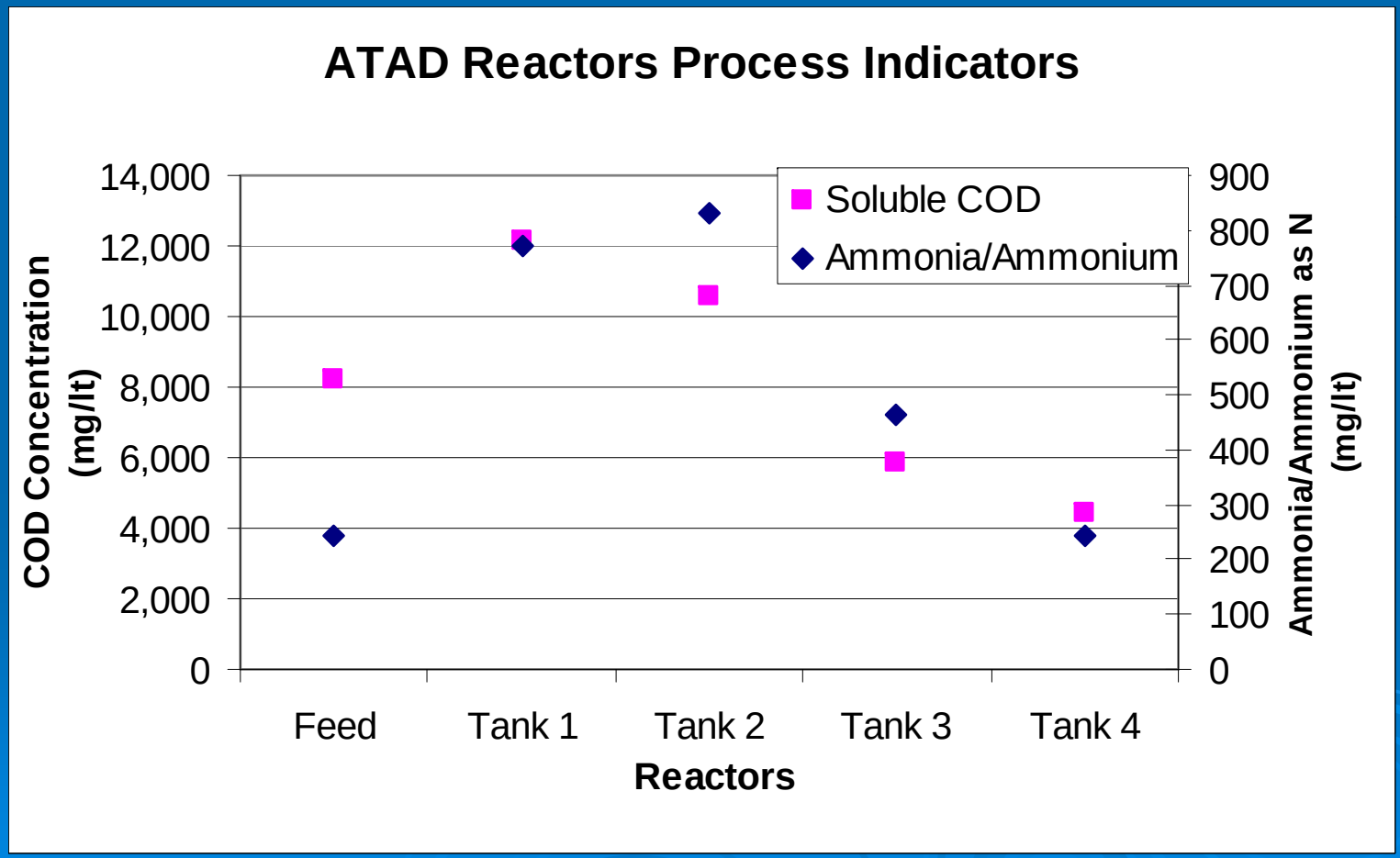
HOW DO YOU MEASURE BIOPOLYMERS?

- You can get graduate students to measure the biopolymers under an electron microscope OR
- Use soluble COD as a substitute measurement (good correlation)

HOW DO YOU REDUCE THE POLYMER DOSE?

- Use pickle liquor or alum (source of + cations) to collapse the biopolymers OR
- Reduce the biopolymers

BIOPOLYMER AND AMMONIA REDUCTION



WHY IS THIS IMPORTANT?

- Biopolymers interfere with polymers in dewatering
- Monovalent ions (like NH4-) interfere with polymers in dewatering
- The SNDR reduces biopolymers (65%)and ammonia (80%)
- Polymer dose at BG: 9.5 Lbs/dry ton

FOCUS ON BG


Microsoft
Virtual Earth™
50 yds
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IMPORTANT EVENTS AT BG

- Supernating with Bentonite
- Polymer experimentation
- Cake solids improvements
- Making a Product
- One reactor operation

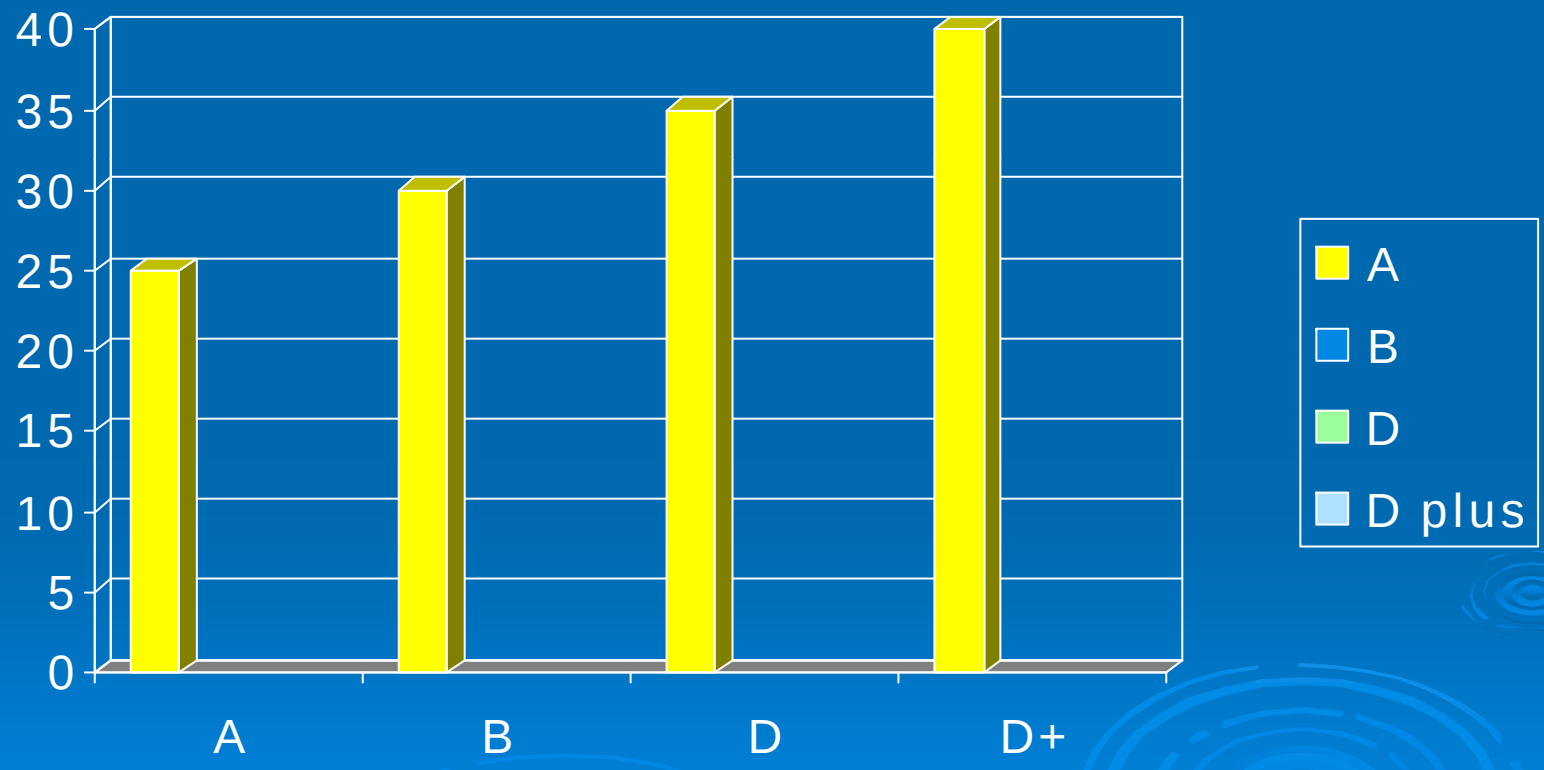
SUPERNATING WITH BENTONITE

- Developing supernating culture took 1 yr
- Bentonite sppeds up settling, improves separation
- Thickens from 2% to 6-9%

POLYMER EXPERIMENTS

- Polymer testing improved cake solids, ended use of iron salts, and reduced dosage and cost

Change in cake solids



DO YOU REALLY EXPECT US TO BELIEVE 40% CAKE SOLIDS? YOU MUST BE A CHEMICAL SALESMAN

- No trickery. Results validated by J&H Labs.
- The secret is 40% volatile solids. Sometimes less.

CHANGES IN CHEMICAL COST

WHY DID THE CAKE SOLIDS GO UP?

- Very low volatile solids allows centrifuge to produce high cake solids
- Thickening before dewatering reduces flow to centrifuge (solids loading limited)
- Reduced flow means increased detention time in machine – more g-minutes (MY OPINION)

WHY DID THE POLYMER DOSE GO DOWN?

- Lower biopolymer
- Lower ammonia
- Higher g-minutes (MY OPINION)(Alfa-Laval says the increased time can lower polymer dose)

TOPSOIL BLENDING SITE VERY HIGH TECH

COST SAVING IN BENEFICIAL REUSE

- LAND APPLICATION
  - $200-$288/DRY TON, DEPENDING ON SOLIDS
- TOPSOIL
  - $88/DRY TON
  - WHICH OF THESE IS LESS?

ONE REACTOR OPERATION

- Using one ATAD reactor reduces pump power by about 140 hp
- Increased load to one reactor should increase reactor temperature and still allow timed feed

ENERGY SAVINGS AT BG

	AEROBIC DIGESTION	ATAD
AIR FLOW	15,000 scfm	2,000 scfm
BLOWER Hp	900	103
PUMP Hp	0	240
TOTAL Hp	900	343
SAVINGS (approx)		**$214,000/yr**

HOW IS BG IMPORTANT TO YOU?

- They don’t make biosolids
- They make a product
- No one is screaming about toxic sludge
- Farmers are complaining about losing their free fertilizer

IS THAT ALL?
(no)

- 75% reduction in beneficial reuse costs
- 60% reduction in energy costs
- No worries about winter

CONCLUSIONS

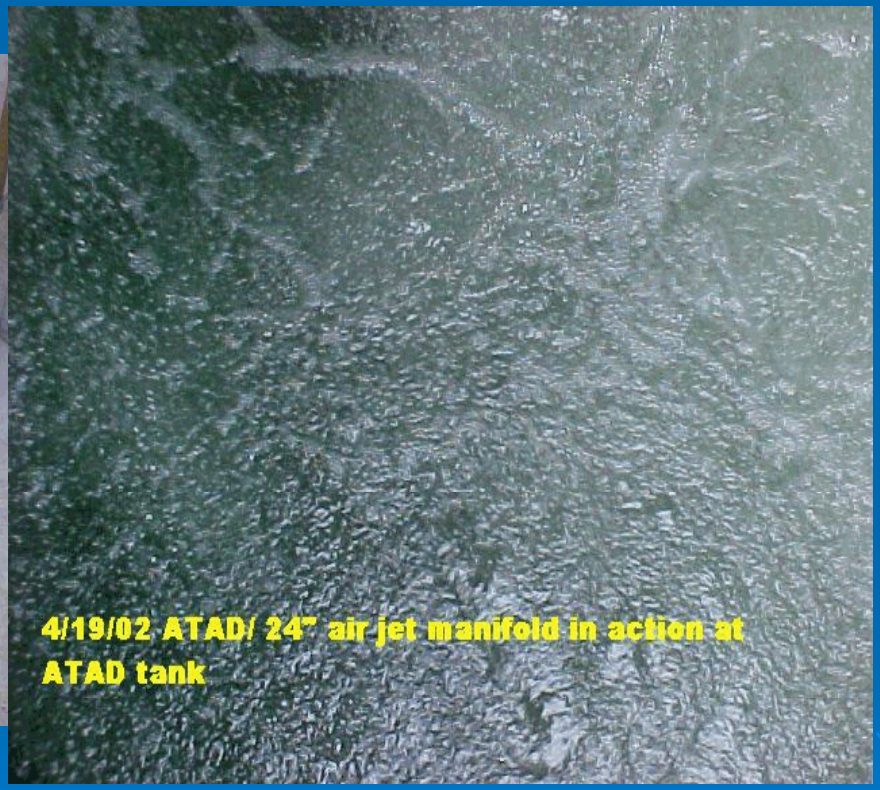
- ATAD is cost effective
- 50-65% TS reduction
- 55-75% VS reduction
- Good supernating
- Good cake solids
- Low polymer dose
- Non-farm market for end product

MANY THANKS TO

- John Donovan, CDM, for his support
- Rich Pressley and Kevin Staton, Thermal Process, for their assistance
- Jim Rozeboom, for being the pathfinder
- Doug Clark, Dave Grolle and John Bella for their hard work

RICH THIS ENDS THE SHOW,

AERATION SYSTEM
THREE RIVERS, MI



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